REMARKS

Claims 1-6 and 9-19 are pending in this application. By this Amendment, claims 1, 3, 6, 9, 12, 13 and 15 are amended to distinguish over the applied references. Reconsideration in view of the forgoing amendments and following remarks is respectfully requested.

Entry of the amendments is proper under 37 CFR §1.116 since the amendments: (a) place the application in condition for allowance (for the reasons discussed herein); (b) do not raise any new issue requiring further search and/or consideration (since the amendments amplify issues previously discussed throughout prosecution); and (c) place the application in better form for appeal, should an appeal be necessary. The amendments are necessary and were not earlier presented because they are made in response to arguments raised in the final rejection. Entry of the amendments is thus respectfully requested.

The Office Action rejects claims 1-3, 6 and 9-17 under 35 U.S.C. §102(b) over JP06-104178 to Shigeru et al. and rejects claims 4, 18 and 19 under 35 U.S.C. §103(a) over Shigeru et al. in view of U.S. Patent 6,328,864 to Ishizawa et al. Applicant respectfully traverses the rejection.

In particular, Applicant submits that Shigeru et al. fails to disclose or suggest a semiconductor manufacturing method in which inert gas is continuously supplied to and exhausted from each chamber as the semiconductor substrate is transferred between the various chambers used in the semiconductor manufacturing method, as recited in each of independent claims 1-3, 6 and 9-11.

The inventors of the invention of this application have found out that, in a chamber kept in a vacuum state under the attainable vacuum, in other words, in a chamber kept in the state in which the chamber is only evacuated while gas supply thereto is stopped, though mechanical contamination can be prevented, it is not possible to effectively prevent chemical contamination caused by the reverse diffusion of oil from a vacuum pump, trace amounts of

volatile impurity components coming from chamber structures (such as shaft seals of a transfer robot or O-rings used as chamber seals), or the like.

The invention of this application is made based on the above findings and its object is to effectively prevent chemical contamination. In order to attain this object, the invention according to claims 1, 4, 6,

6, 12 and 15 of this application has a first step of carrying a substrate into a preliminary chamber from an external part, a second step of continuously supplying and exhausting an inert gas to and from said preliminary chamber at least from a time before opening a first gate valve between the aforesaid preliminary chamber and a transfer chamber, after the substrate is carried into the aforesaid preliminary chamber, a third step of transferring the aforesaid substrate to the aforesaid transfer chamber from the aforesaid preliminary chamber, in a state in which the inert gas is continuously supplied and exhausted to and from the aforesaid preliminary chamber and the aforesaid transfer chamber, after the aforesaid first gate valve is opened, a fourth step of transferring the aforesaid substrate to a process chamber from the aforesaid transfer chamber in a state in which the inert gas is continuously supplied and exhausted to and from the aforesaid transfer chamber and the aforesaid process chamber, after a second gate valve between the aforesaid transfer chamber and the aforesaid process chamber is opened, and a fifth step of subjecting the substrate to predetermined processing in the aforesaid process chamber.

Especially, the invention according to claims 1, 4, 5, 6, 12 and 15 of this application is characterized in that an inert gas is continuously supplied and exhausted to and from the aforesaid preliminary chamber at least from a time before opening the first gate valve between aforesaid preliminary chamber and the transfer chamber, after the substrate is carried into the preliminary chamber. This structure allows a gas flow in the exhaust direction to be formed in the preliminary chamber at least from the time before opening the first gate valve,

after the substrate is carried into the preliminary chamber. Consequently, it is made possible to effectively prevent the substrate present in the preliminary chamber from undergoing chemical contamination caused by the reverse diffusion of oil from a vacuum pump, trace amounts of volatile impurity components coming from chamber structures, and the like, before opening the first gate valve, so that substrate processing quality can be enhanced. Refer to lines 14 to 23 on page 6, lines 17 to 24 on page 15, and lines 10 to 29 on page 18 in the specification of this application.

Further, since it is possible to effectively prevent chemical contamination without using a turbo molecular pump, a transfer robot with which a super-high vacuum can be attained, metal O-rings, or the like, chemical contamination can be effectively prevented at low cost and with easy maintenance. Refer to lines 1 to 13 on page 19 in the specification of this application.

On the other hand, in the invention of Shigeru et al., when a substrate is transferred from an introduction chamber 7 to a transfer chamber 1, and from the transfer chamber 1 to a vacuum process chamber 4, a high purity argon gas always continues to be introduced into the transfer chamber 1 and the process chamber 4, so that pressure inside the transfer chamber 1 and the process chamber 4 is kept at predetermined pressure.

The invention disclosed in Shigeru et al. is similar to the invention according to claims 1, 4, 5, 6,12 and 18 of this application in the point that the inert gas is supplied and exhausted to and from the transfer chamber 1 and the vacuum process chamber 4 when the substrate is transferred from the transfer chamber 1 to the vacuum process chamber 4. However, concerning the introduction 7, Shigeru et al. discloses "vacuum evacuation is performed", but does not disclose "inert gas is supplied." See paragraph 0018 of Shigeru et al. The invention described in Shigeru et al. excludes the introduction chamber 7 from the chambers kept in the state in which the inert gas is supplied and exhausted. This is obvious from the description

that "...Also in this apparatus, after all of the chambers other than the introduction chamber and the exhaust chamber of 113 and 114 are evacuated to ultra-high vacuum as in the previous embodiments, the high purity inert gas is introduced into each transfer chamber and the vacuum process chamber to keep them at pressure of 10^{-8} torr range, and vacuum process for the substrate is performed," in lines 6 to 9 of paragraph [0026] of Shigeru et al.

Consequently, Shigeru et al. does, not disclose the structure in which after the substrate is carried into the introduction chamber 7 corresponding to the preliminary chamber of this application, the inert gas is introduced and exhaust to and from the introduction chamber 7 at least before the gate valve 14 between the introduction chamber 7 and the transfer chamber 1 is opened. As a result, the invention disclosed in Shigeru et al. cannot prevent the substrate present in the introduction chamber 7 from undergoing chemical contamination before the gate valve 14 is opened.

There is the description that, "Since the introduction chamber is at lower pressure than the transfer chamber at this time, a high purity argon gas which is introduced in the transfer chamber flows toward the introduction chamber, and a flow of the gas to the transfer chamber from the introduction chamber hardy exists," in line 19 to line 22 of paragraph [0018] of Shigeru et al. Accordingly, in the invention described in Shigeru et al., if the transfer chamber 1 and the introduction chamber 7 are connected by opening the gate valve 14, the introduction chamber 7 is automatically brought into the state in which the inert gas is supplied and exhausted. However, this takes place after the gate valve 14 is opened, and the point that the inert gas is supplied and exhausted to and from the introduction chamber before the gate valve 14 is opened is not disclosed at all in Shigeru et al.

It is because in the invention disclosed in Shigeru et al., no attention is paid to the object of the invention according to claims 1, 4, 5, 6,12 and 15 of this application that Shigeru

et al. does not disclose at all the structure in which an inert gas is supplied and exhausted to and from the introduction chamber 7 before the gate valve 14 is opened.

The invention according to claims 1, 4, 5, 6, 12 and 16 of this application especially has its object to prevent chemical contamination by reverse diffusion of oil and the like from a vacuum pump during the operation of the vacuum pump. In order to attain this object in the preliminary chamber, it is necessary to supply and exhaust an inert gas to and from the preliminary chamber, at least before opening the first gate valve between the preliminary chamber and the transfer chamber, after the substrate is carried into the preliminary chamber. This is because when the substrate is transferred into the preliminary chamber, the vacuum pump coupled to the preliminary chamber is operated. On the other hand, the invention disclosed in Shigeru et al. has its object to remove the remaining gas such as water inside the vacuum process chamber, and reduce occurrence of dust from the sliding portions of the transfer robot inside the transfer chamber, as described in paragraph [0008] to [0011], and does not intend to prevent chemical contamination by reverse diffusion of oil and the like from the vacuum pump. Accordingly, the invention disclosed in Shigeru et al. does not consider that the substrate carried into the introduction chamber undergoes chemical contamination by reverse diffusion of oil and the like from the vacuum pump. This is the reason why Shigeru et al. does not disclose the structure in which an inert gas is supplied and exhausted to and from the introduction chamber 7 before opening the gate valve 14.

As is detailed above, the invention according to claims 1, 4, 5, 6, 12 and 15 of this application has a different structure from that of the invention disclosed in Shigeru et al., and enables to obtainment of excellent

effects that are not obtainable in Shigeru et al. Moreover, Shigeru et al. does not disclose any description indicating the object, structure, or effect of the invention according to claims 1, 4,

5, 6,12 and 15 of this application. Therefore, the invention according to claims 1, 4, 5, 6, 12 and 15 of this application is patentable over Shigeru et al.

Also, the invention according to claims 1, 4, 5, 6, 12 and 15 of this application is patentable over Ishizawa et al. Ishizawa et al. discloses an invention so structured that, after a wafer W is transferred from a vacuum process chamber 104a to a common transfer chamber 102, a gas within the common transfer chamber 102 is replaced and the wafer W is thereafter transferred from the common transfer chamber 102 to the vacuum process chamber 104b, and in such a structure, when the gas within the common transfer chamber 102 is replaced, an opening/closing valve 116 is closed to stop the gas supply to the common transfer chamber 102 and the common transfer chamber 102 is evacuated in this state, and thereafter, the opening/closing valve 116 is opened to instantly supply the common transfer chamber 102 with an inert gas loaded in advance in a gas loading chamber 118, thereby boosting the inner pressure of the common transfer chamber 102.

The invention disclosed in Ishizawa et al. is similar to the invention according to claims 1, 4, 5, 6, 12, and 15 of this application in that the common transfer chamber 102 is evacuated while the inert gas is supplied thereto when the wafer W is transferred from the vacuum process chamber 104a to the common transfer chamber 102. However, in Ishikawa et al., as in Shigeru et al., there is no description that an inert gas is supplied and exhausted as for the cassette chamber 106a corresponding to the preliminary chamber of this application. There is no such description as for the vacuum process chambers 104a, 104b and 104c. Further, in the invention described in Ishikawa et al., when the gas within the common transfer chamber 102 is replaced, the supply of the inert gas is stopped and only the evacuation is conducted while the wafer W is present in the common transfer chamber 102 and supply and exhaust of a gas are not conducted.

As described above, Ishizawa et al. does not disclose at all the structure in which an inert gas is supplied and exhausted to and from the cassette chamber and the vacuum process chamber during transfer of the substrate and the structure in which an inert gas is supplied and exhausted to and from the common transfer chamber during the gas replacement step. Consequently, the invention disclosed in Ishizawa et al. cannot prevent the substrate from undergoing chemical contamination, either.

The reason why the above-described structure is not disclosed in Ishizawa et al. is that in the invention disclosed in Ishizawa et al., as well as in the invention disclosed in Shigeru et al., no attention is paid to the object of the invention according to claims 1, 4, 5, 6, 12 and 15 of this application. The invention disclosed in Ishizawa et al. has its object to exhaust various kinds of gases and particles existing in the common transfer chamber and having adverse effects on the object to be processed, and is not intended to prevent chemical contamination such as contamination by reverse diffusion of oil from the vacuum pump. Accordingly, the invention disclosed in Ishizawa et al. does not consider that the substrate carried into the cassette chamber and the like undergoes chemical contamination by reverse diffusion of oil and the like from the vacuum pump.

As is described in detail above, the invention according to claims 1, 4, 6, 6, 12 and 16 of this application has a different object, structure and effect from those of the invention disclosed in Ishizawa et al., and is therefore patentable over Ishizawa et al.

Regarding claims 2 and 13, in these claims, during three steps of a substrate transferring step, an inert gas is continuously supplied and exhausted to and from all of three chambers. This structure allows a gas flow in the exhaust direction to be formed within all of the three chambers during the three steps included in the substrate transferring step. This makes it possible to more effectively prevent the aforesaid chemical contamination.

The structure in which an inert gas is continuously supplied and exhausted to and from all of three chambers during transfer of the substrate like this is not disclosed or indicated in Shigeru et al. or Ishizawa et al. Therefore, the invention according to claims 2 and 13 is patentable over Shigeru et al. and Ishizawa et al.

In the context of claim 2 of this application, the Office Action states that, "Shigeru et al. indicates that pressure is kept constant by supplying and exhausting an inert gas to and from all of three chambers during transfer of a substrate (Para. 0017)," in line 9 to line 11 on page 3 of Office Action. However, paragraph [0017] of Shigeru et al. describes that a gas is supplied to the vacuum process chamber when the substrate is processed in the vacuum process chamber, but does not describe that a gas is supplied to the introduction chamber, the transfer chamber, and the vacuum process chamber when the substrate is transferred to the vacuum process chamber through the transfer chamber from the introduction chamber. Accordingly, the invention described in this paragraph [0017] does not meet the requirements that "an inert gas is continuously supplied and exhausted to and from all of three chambers during three steps of a substrate transferring step," as stated in claims 2 and 13 of this application.

Paragraph [0018] of Shigeru et al. also discloses an embodiment in which an inert gas is supplied and exhausted to and from the transfer chamber 1 and the vacuum process chamber 4 during transfer of the substrate, as described above. However, in this embodiment, vacuum evacuation is only performed for the introduction chamber 7, as described above, and an inert gas is not supplied thereto. Accordingly, the invention described in paragraph [0018] does not meet the requirements that "an inert gas is supplied and exhausted to and from all of three chambers during three steps of a substrate transferring step," as stated in claims 2 and 13 of this application.

In the invention described in paragraph [0018], the inert gas introduced in the transfer chamber 1 flows toward the introduction chamber 7 in the state in which the transfer chamber

1 and the introduction chamber 7 are connected to each other. Accordingly, in this situation, the state in which the inert gas is supplied and exhausted is established in the introduction chamber 7. Consequently, in this situation, the state in which the inert gas is supplied and exhausted is established in three chambers of the introduction chamber 7, the transfer chamber 1 and the vacuum chamber 4. However, in the state in which transfer of the substrate to the transfer chamber 1 from the introduction chamber 7 is finished and the gate valve 14 is closed, a flow of the inert gas to the introduction chamber 7 from the transfer chamber 1 is blocked by the gate valve 14. Due to this, in the state in which this gate valve is closed, the state in which an inert gas is supplied and exhausted is not established in the introduction chamber 7. In other words, in the step of holding the substrate in the transfer chamber 1 by closing the gate valve 14 and in the step of transferring the substrate from the transfer chamber 1 to the vacuum process chamber 4 among the substrate transferring steps, the introduction chamber 1 is not brought into the state in which an inert gas is supplied and exhausted to and from. Consequently, even if it is taken into consideration that an inert gas flows from the transfer chamber 1 to the introduction chamber 7 in the state in which the gate valve 14 is opened, the invention described in paragraph [0018] does not meet the requirements that "an inert gas is supplied and exhausted to and from all three chambers during three steps of a substrate transferring step," as recited in claims 2 and 13 of this application.

Regarding claims 3 and 14, in these claims, an inert gas is continuously supplied to all of the

chambers coupled to a vacuum pump among three chambers and is exhausted from these chambers using the vacuum pump during three steps of a substrate transferring step. This structure allows a gas flow in the exhaust direction to be formed within all of the chambers coupled to the vacuum pump among the three chambers during the three steps included in the

substrate transferring step. This makes it possible to effectively prevent the aforesaid chemical contamination in all of the chambers coupled to the vacuum pump. The structure in which an inert gas is continuously supplied and exhausted to and from all of the chambers coupled to the vacuum pump, during transfer of the substrate is not suggested or disclosed in either Shigeru et al. or Ishizawa et al.

In Shigeru et al., a vacuum pump 43 is coupled to at least the introduction chamber 7. However, an inert gas is not continuously supplied to this introduction chamber 7 during transfer of the substrate. That is, when the gate valve 14 is opened, an inert gas is supplied from the transfer chamber 1 to this introduction chamber 7 as described above, but when the gate valve 14 is closed, the inert gas is not supplied to the introduction chamber 7. Accordingly, Shigeru et al. does not meet the requirements that "an inert gas is continuously supplied and exhausted to and from all of the chambers coupled to the vacuum pump, during transfer of the substrate," as recited in claims 3 and 14 of this application.

Moreover, in Ishizawa et al., a vacuum-evacuating mechanism 128 is coupled to at least the common transfer chamber 102. However, an inert gas is not continuously supplied to this common transfer chamber 102 during transfer of the substrate. That is, an inert gas is not supplied to this common transfer chamber 102, during evacuation, in a gas replacement step during transfer of the substrate as described above. Accordingly, the invention disclosed in Ishizawa et al. does not meet the requirements that "an inert gas is continuously supplied and exhausted to and from siLthe chambers coupled to the vacuum pump, during transfer of the substrate," as recited in claims 3 and 14.

From the above, it is obvious that Shigeru et al. and Ishizawa et al. are incapable of achieving the effects of the invention according to claims 3 and 14 of this application. Consequently, claims 3 and 14 of this application are patentable over Shigeru et al. and Ishizawa et al.

Regarding claim 9, in this claim, at least one vacuum pump is coupled to three chambers, and in this vacuum pump, an inert gas is continuously introduced from its upstream side, and the vacuum pump is operated to exhaust the inert gas in all of the chambers, during three steps of a substrate transferring step. This structure can effectively prevent chemical contamination caused by the reverse diffusion of oil from the vacuum pump in all of the chambers. Note that introducing an inert gas through three chambers when the inert gas is introduced from its upstream side to the vacuum pump allows the gas flow in the exhaust direction to be formed both in the three chambers and creates an exhaust system. Consequently, it is possible to effectively prevent not only chemical contamination caused by the reverse diffusion of oil from the vacuum pump, but also chemical contamination caused by volatile impurity components coming from the chamber structures, and so on.

The structure in which an inert gas is continuously introduced from its upstream side to at least one vacuum pump coupled to three of the chambers and the inert gas in all the chambers is exhausted with the vacuum pump, during transfer of the substrate, is not disclosed or suggested in either Shigeru et al. or Ishizawa et al. In Shigeru et al., the vacuum pump 43 is coupled to the introduction chamber 7. However, an inert gas is not continuously introduced from its upstream side to this vacuum pump 43 during transfer of the substrate. This is because an inert gas is not supplied to the introduction chamber 7 from the transfer chamber 1 when the gate valve 14 is closed as described above. Accordingly, the invention disclosed in this Shigeru et al. does not meet the requirements that "an inert gas is continuously introduced from its upstream side to at least one vacuum pump coupled to three chambers during transfer of the substrate," as recited in claim 9 of this application.

Moreover, in Ishizawa et al., the vacuum-evacuating mechanism 128 is coupled to the common transfer chamber 102. However, an inert gas is not continuously introduced from its

upstream side to this vacuum-evacuating mechanism 128 during transfer of the substrate. This is because an inert gas is not supplied to the common transfer chamber 102 in the gas replacement step during transfer of the substrate, as described above. Accordingly, Ishizawa et al. does not meet the requirements that "an inert gas is continuously introduced from its upstream side to at least one vacuum pump coupled to three chambers during transfer of the substrate," as recited in claim 9 of this application.

From the above, it is obvious that Shigeru et al. and Ishizawa et al. are incapable of achieving the benefits of claim 9 of this application. Consequently, claim 9 is patentable over Shigeru et al. and Ishizawa et al.

Regarding claims 10, 16 and 18, in these claims, an inert gas is continuously supplied and exhausted to and from a preliminary chamber during a substrate transferring step. This structure allows a gas flow in the exhaust direction to be formed in the preliminary chamber during the substrate transferring step. Consequently, chemical contamination can be effectively prevented also in the preliminary chamber. The structure in which an inert gas is continuously supplied to the preliminary chamber during transfer of the substrate is not disclosed or suggested in either Shigeru et al. or Ishizawa et al., as mentioned above. Therefore, claims 10, 16, and 18 are patentable over Ishizawa et al.

Regarding claims 11, 17 and 19, these claims comprise the step of continuously supplying and exhausting an inert gas to and from a preliminary chamber while a substrate is present in the preliminary chamber after the substrate is transferred into the preliminary chamber. This structure allows a gas flow in the exhaust direction to be formed in the preliminary chamber while the substrate is present in the preliminary chamber. Consequently, the following effect is obtainable: when the plural substrates held in a cassette are transferred to the preliminary chamber, a substrate is constantly present in the preliminary chamber after the cassette is inserted thereto. Even in such a case, in the invention according to claims 11,

17, and 19, chemical contamination to all the substrates held in the cassette can be effectively prevented.

The structure in which an inert gas is continuously supplied and exhausted to and from a preliminary chamber while a substrate is present in the preliminary chamber after the substrate is carried into the preliminary chamber like this is not disclosed or indicated in Shigeru et al. or in Ishizawa et al., either, as mentioned under' (1) Claims 1, 4, 5, 6, 12 and 15.

In view of the foregoing, Applicant respectfully requests that the rejection of claims 1-3, 6 and 9-17 under 35 U.S.C. §102(b) as well as the rejection of claims 4, 18 and 19 under 35 U.S.C. §103(a) be withdrawn.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-6 and 9-19 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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Enclosure:
Petition for Extension of Time (Large Entity)

Date: October 3, 2003

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